Non-coding RNA as tool for the active control of stem cell differentiation

Grant Award Details

Non-coding RNA as tool for the active control of stem cell differentiation

Grant Type: SEED Grant

Grant Number: RS1-00477

Investigator:

Name:	Frank Sauer
Institution:	University of California, Riverside
Type:	PI

Human Stem Cell Use: Embryonic Stem Cell

Award Value: $571,650

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Progress Reports

Reporting Period: Year 2

View Report

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Grant Application Details

Application Title: Non-coding RNA as tool for the active control of stem cell differentiation

Public Abstract:

Stem cells are multipotent, meaning that they can develop into any cell type of the human body. Biomedical applications propose that, after introduction into humans, stem cells could replenish damaged or lost cells in human bodies and thereby cure human diseases such as Parkinson, Alzheimer's, and diabetes. One prerequisite for the success of the biomedical application of stem cells are tools that actively control the development of a stem cell into any given cell type, such as neurons, muscle cells, or insulin-producing pancreatic cells. However, the tools directing stem cell differentiation are only now being discovered. The proposed research project intends to fill this gap and uses a novel research approach to develop tools, which can control to development of cells (cell differentiation) into any desired cell type.

The research approach is based on studies, indicating that a novel group of non-coding RNAs plays an important role in cell differentiation in the fruit fly and mice. The non-coding RNA originate from and control the expression of genes, whose activities control cell differentiation. We have shown that the introduction of non-coding RNA into cells changes the developmental fate of cells, suggesting that the non-coding RNA represent tools that control the differentiation of cells including stem cells. We have identified 32 non-coding RNAs in human cells, which originate from different regulators of cell differentiation and are transcribed in differentiated but not human stem cells. Thus, the specific working hypothesis of the research project is that non-coding RNA control the differentiation of human stem cells.

To test that hypothesis, we shall assess whether non-coding RNA can induce stem cell differentiation. First (Aim 1), we shall test whether the introduction of non-coding RNA into human stem cells activates the expression of genes, whose activities control cell differentiation. To confirm the results of Aim 1, we shall assess whether non-coding RNA-mediated expression of key regulatory genes of cell differentiation coincides with the recruitment of regulatory proteins, which establish and maintain the expression of the key regulatory genes throughout the entire life. This is important, as an actively controlled progression of stem cell to differentiated cell is only then successful, when the differentiated cell maintains its identity throughout the entire life. Third, we shall elucidate whether activation of key regulatory genes by non-coding RNA induces cell differentiation. In summary, the proposed project will provide novel insights into the molecular mechanisms underlying stem cell differentiation and novel molecular tools to control stem cell differentiation. Our efforts will significantly contribute towards the development of biomedical applications that allow the utilization of stem cells in the treatment of human diseases.

Statement of Benefit to California:	The long-term goal of the proposed project is the development of molecular tools, which are capable to actively control the differentiation of stem cells. California will benefit from the proposed research project in several ways. ResearchThe proposed research project represents a novel avenue of stem cell research. Tools, which can actively control stem cell differentiation, remain elusive. Thus, the proposed development of such tools represents a major advancement in stem cell research and provides California with cutting-edge technology. In addition, the research project provides training opportunities for the next generation of stem cell researchers. EconomyThe proposed research project will benefit the economy of the State of California. The proposed research provides employment opportunities for researchers. In addition, the developed technology can be transferred into a company setting (e.g., in form of a start-up company) that provides additional employment opportunities and tax revenue for the State of California. The generated revenue will provide compensation for the State of California that is likely to exceed the amount of the initial investment by the Stare of California into the proposed research proposal by many magnitudes. Public HealthThe proposed project has the potential to make a significant contribution to stem cell research in particular the biomedical application of stem cells. In the long-term, technology derived from this project will contribute to the development of assays to treat human diseases. Thus, the proposed project will provide the citizens of California with novel biomedical assays capable of treating diseases such as diabetes, Parkinson and Alzheimer's.

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